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# **GINNING PERFORMANCE OF SOUTHEASTERN COTTON HARVESTED BY FINGER STRIPPERS**

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# GINNING PERFORMANCE OF SOUTHEASTERN COTTON HARVESTED BY FINGER STRIPPERS

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## ABSTRACT

Fifteen bales of open-boll cotton harvested with a finger stripper (equipped with an extractor) from a narrow-row planting were subjected to five ginning treatments, which differed in sequence and amount of seed-cotton-cleaning and lint-cleaning equipment. Most bales were reduced in grade because of bark content, indicating the need for further research on cleaning and extraction of stripper-harvested cotton. Before ginning, foreign-matter content of seed cotton was approximately 25 percent, utilizing cottons harvested by a stripper equipped with a field extractor. Efficiency of seed-cotton cleaning in the gin was approximately 50 percent. Grades were in the Low Middling to Strict Low Middling range on a composite basis, with color and leaf elements somewhat better than the composite. Good control of moisture was obtained, but at a lower level than desired. Ginning treatments had very little effect on staple length or fiber properties. Ginning treatments did not affect bale weights, unit lint values, or bale values; however, the trend for highest bale value was toward the treatment which included double drying, cleaning and extracting, and three lint cleaners in series.

## INTRODUCTION

Interest in the production of cotton in rows that are narrower than the conventional 38- to 40-inch width has raised many questions as to whether these methods are feasible for cottons grown in the rainy Southeast. Considerable research and extension effort has been expended, and is continuing, at Clemson and Auburn Universities and other locations to evaluate narrow-row systems in terms of agronomic characteristics, production potential, cost reduction, and pest management. As with any new system, these factors will require much attention.

Once-over harvesting, usually with some type of stripper, is an integral part of the new narrow-row production system. Unfortunately, past research on stripper harvesting in the Southeast has not been encouraging. Several types of harvesters have been

used or developed for harvesting cotton grown in narrow rows, including the cotton combine with a cutter bar and horizontally oriented spindle-picker drums, the finger stripper, and in some cases, the brush roll stripper.

Nutt, Evans, and Balk,<sup>2</sup> who conducted research on steel roll strippers in South Carolina in the late 1940's and early 1950's, found stripping to be impractical for the area at that time because of lack of an acceptable variety, inadequate weed control, and lack of dependable defoliation methods. Similar studies were made in Alabama during 1948-56, with essentially the same conclusions.

Corley and Kirk<sup>3</sup> reported in 1967 on picker-stripper studies conducted at Auburn during 1963-66. They concluded that the brush stripper

<sup>2</sup>Nutt, G. B., Evans, J. S., and Balk, W. A. 1950. Harvesting cotton with spindle pickers and strippers. S.C. Exp. Stn., Clemson Agric. Coll., 62d Annu. Rep., pp. 13-16.

<sup>3</sup>Corley, T. E., and Kirk, I. W. 1967. Picker versus stripper harvesting of cotton. Agric. Exp. Stn. Auburn Univ. Highlights of Agricultural Research 14(3): 9.

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had potential for lowering harvesting costs, but was not likely to gain wide acceptance. Reasons cited were inadequate ginning facilities for stripped cotton, lack of high-yielding, quality varieties suitable for stripping, greater demand for quality cotton and larger discounts for lower grades, and grade and yield losses in some years from weathering with any method of once-over harvest.

Garner, Shanklin, and LaFerney<sup>4</sup> reported on large-scale picker-stripper studies conducted at Clemson, S.C., during 1964-66, utilizing cottons from South Carolina and Alabama. Some of these cottons were processed through pilot-scale spinning. The performance of stripped cotton was lower than that of spindle-picked cotton when both were handled in the conventional manner through ginning and pilot-scale spinning.

Despite the poor performance of stripper harvesters in the past, growers in the Southeast are expressing considerable interest in narrow-row systems. For instance, a grower-ginner in Colquitt County, Ga., planted his entire allotment of 350-400 acres in rows 14 inches apart on 38-inch beds in 1971 and 1972. In 1972, another grower in Aiken County, S.C., planted his allotted 240 acres in four rows, 15 inches apart with 31-inch middles. The Southeastern Cotton Ginning Research Laboratory at Clemson, S.C., conducted ginning studies on cottons from both of these growers in 1971 and 1972.

The interest in narrow-row cotton production in the Southeast has prompted several producers to purchase finger strippers. Observations have shown that cotton harvested with the finger stripper contains much more trash than cotton harvested with conventional spindle pickers. In tests at Clemson, S.C., the trash level before ginning has ranged from 22 to 35 percent, depending partly on whether the stripper had a cleaner. This compares with a normal trash level of 5 to 8 percent in spindle-picked cotton. Many gins in the Southeast, even though elaborately equipped by most standards for spindle-picked cottons, may not have proper equipment to handle the higher trash volumes and larger plant particles associated with strippers.

The objective of this research was to determine the ginning performance and fiber quality of cottons harvested by finger strippers at several locations in the Southeast.

## GINNING TESTS AND RESULTS

A limited test conducted in 1971, using four bales of cotton harvested with a commercial finger stripper in Colquitt County, Ga., met with mechanical difficulties. A ginning setup consisting of a conventional overhead and three lint cleaners was used. The four bales were in the Strict Low Middling range before reduction, and graded 61/51, 52/42, 53/43, and 53/43, respectively, with all reductions attributable to bark content.<sup>5</sup> Net turnout was 22.6 percent, 2,125 pounds of seed cotton being required to make a 480-pound (net weight) bale of lint. The trash content per bale was 566 pounds; moisture and other loss was 161 pounds, for a total loss of 727 pounds per 480-pound bale. Chokages in the overhead seed-cotton-cleaning equipment and buildup of sticks in the seed roll caused considerable difficulty in processing this cotton through the ginning system.

In 1972, 15 bales of the predominant variety of cotton from Georgia, Alabama, and South Carolina were needed for 5 ginning treatments. Only three bales of cotton harvested by a commercial finger stripper in Colquitt County, Ga., could be obtained. These were processed through a single ginning setup, including two stick machines and three lint cleaners. One bale was graded Low Middling Light Spotted with a staple length of 33 (32d inch) and a micronaire of 3.7. The other two bales were graded Low Middling Light Spotted, reduced from Strict Low Middling Light Spotted because of grass content. Staple lengths and micronaire were similar to the other bale. Cotton was not available from Auburn, Ala., because the yield from the narrow-row plots was not sufficient to provide enough cotton for ginning tests.

Fifteen bales of 'Coker 310' and 'McNair 210' cotton were obtained from a private producer in Aiken County, S.C. Bale-size lots were used. The cottons were harvested and ginned in late November. The harvester was an Allis-Chalmers 760XTB finger stripper with a 154-inch stripping head. It also included a 36-inch extractor manufactured by the Continental/Moss-Gordin Gin Company.

Ginning treatments consisted of the following sequences and amounts of ginning machinery:

| No. 1 | No. 2 | No. 3 | No. 4 | No. 5 |
|-------|-------|-------|-------|-------|
| TD    | TD    | TD    | TD    | TD    |

<sup>5</sup>Grade codes: 61, Strict Good Ordinary. 53, Low Middling Spotted. 52, Low Middling Light Spotted. 51, Low Middling. 43, Strict Low Middling Spotted. 42, Strict Low Middling Light Spotted.

<sup>4</sup>Garner, W. E., Shanklin, E. H., and LaFerney, P. E. 1970. Fiber quality and ginning performance of machine picked and stripped cotton, Southeastern area, 1964-66. U.S. Dep. Agric. Mark. Res. Rep. No. 852, 30 pp.

|     |     |     |     |     |
|-----|-----|-----|-----|-----|
| 7C  | 7C  | SM  | 7C  | SM  |
| SM  | SM  | TD  | SM  | TD  |
| TD  | TD  | 7C  | TD  | 7C  |
| 7C  | 7C  | SM  | 7C  | SM  |
| —   | SM  | 7C  | SM  | 7C  |
| ECF | ECF | ECF | ECF | ECF |
| GIN | GIN | GIN | GIN | GIN |
| 2LC | 2LC | 2LC | 3LC | 3LC |

## Seed-Cotton Foreign-Matter Content

Foreign matter in the wagon samples of seed cotton averaged 25.4 percent (table 1). As noted earlier, the stripper was equipped with a Continental/Moss-Gordin extractor. The breakdown of trash components by weight was as follows:

|                    | Percent |
|--------------------|---------|
| Burs .....         | 51.2    |
| Sticks .....       | 26.9    |
| Grass .....        | 2.2     |
| Large leaves ..... | 6.4     |
| Small leaves ..... | 5.2     |
| Motes .....        | 8.1     |
| Total .....        | 100.0   |

In the above listing, TD is 24-shelf tower drier; 7C is 7-cylinder inclined cleaner; SM is stick and green-leaf machine; ECF is extractor-cleaner-feeder; and LC is lint cleaner.

These ginning treatments can be conveniently described as follows:

- No. 1=Conventional.
- No. 2=Clean-extract—2 lint cleaners.
- No. 3=Extract-clean—2 lint cleaners.
- No. 4=Clean-extract—3 lint cleaners.
- No. 5=Extract-clean—3 lint cleaners.

Drier inlet temperatures were adjusted for a target fiber moisture content of 6 percent at the ginning point. Drier temperatures of 200° to 250° F were used. Ginning rates were determined by the condition of the seed cotton. Moisture, trash, and fiber samples were extracted at different stages of gin processing.

Foreign matter in feeder samples of seed cotton averaged 12.4 percent, for an overall cleaning efficiency of 51 percent in the overhead cleaning system (table 2). The cleaning efficiency was 54 percent for burs, 32 percent for sticks, 38 percent for grass, 98 percent for large leaves, 69 percent for small leaves, and 50 percent for motes.

## Moisture Content

Seed-cotton moisture content averaged 13.6 percent at the wagon and 10.5 percent at the feeder

TABLE 1.—*Foreign matter in seed cotton, wagon samples*<sup>1</sup>

[Percent]

| Gin treatment            | Burs  | Sticks | Grass | Large leaves | Small leaves | Motes | Total trash |
|--------------------------|-------|--------|-------|--------------|--------------|-------|-------------|
| 1—Conventional .....     | 13.5a | 6.4a   | 0.3b  | 1.5a         | 1.2b         | 1.9a  | 24.8a       |
| 2—Clean-extract—2LC..... | 12.6a | 7.4a   | .5bc  | 1.8a         | 1.4a         | 2.2a  | 25.9a       |
| 3—Extract-clean—2LC..... | 12.9a | 6.4a   | .8ac  | 1.7a         | 1.4ab        | 2.2a  | 25.4a       |
| 4—Clean-extract—3LC..... | 12.6a | 6.8a   | 1.0a  | 1.3a         | 1.2ab        | 2.0a  | 24.9a       |
| 5—Extract-clean—3LC..... | 13.5a | 7.2a   | .3b   | 1.9a         | 1.3ab        | 2.0a  | 26.2a       |
| Average .....            | 13.0  | 6.8    | .6    | 1.6          | 1.3          | 2.1   | 25.4        |

<sup>1</sup>Means in a column not followed by a common letter differ at the 5-percent level of significance, as determined by Duncan's multiple-range test.

TABLE 2.—*Foreign matter in seed cotton, feeder samples*<sup>1</sup>

[Percent]

| Gin treatment            | Burs  | Sticks | Grass | Large leaves | Small leaves | Motes | Total trash |
|--------------------------|-------|--------|-------|--------------|--------------|-------|-------------|
| 1—Conventional .....     | 7.7a  | 5.1a   | .1c   | .1a          | .5a          | 1.1ab | 14.6a       |
| 2—Clean-extract—2LC..... | 5.2b  | 5.1a   | .3abc | .0a          | .5a          | 1.3a  | 12.4ab      |
| 3—Extract-clean—2LC..... | 5.3b  | 4.1a   | .5ab  | .0a          | .3b          | .9ab  | 11.1b       |
| 4—Clean-extract—3LC..... | 5.8ab | 4.4a   | .6a   | .1a          | .4ab         | 1.1ab | 12.4ab      |
| 5—Extract-clean—3LC..... | 5.7ab | 4.5a   | .3bc  | .0a          | .3b          | .8b   | 11.6ab      |
| Average .....            | 5.9   | 4.7    | .4    | .0           | .4           | 1.0   | 12.4        |

<sup>1</sup>Means in a column not followed by a common letter differ at the 5-percent level of significance, as determined by Duncan's multiple-range test.

apron (table 3). Seed moisture averaged 12.4 percent. The lint-moisture content averaged 3.9 percent, which was below the target of 6.0 percent. None of the moisture differences were significant.

## Smith-Doxey Classification

The average grade index was reduced from 91.5 to 83.7, primarily because of bark content (table 4). Staple length and micronaire averaged 34.1 and 3.8, respectively. There were no significant differences among ginning treatments for grade index (both before and after reduction), staple length, or micronaire. Gin treatment No. 4 produced the highest numerical value for grade index, both before and after reductions by the classer.

## Committee Classification

In addition to Smith-Doxey classification, committee classification, which gives a more detailed breakdown of grade elements and staple lengths based on three subsamples per test lot, was obtained at the Classing Office of the Agricultural Marketing Service, Columbia, S.C. Composite grade index before and after reductions was slightly higher than for Smith-Doxey classification, averaging 94.5 and 88.5, respectively (table 5).

Color index at 97.7 and leaf index at 95.1 were relatively high, with no differences among ginning treatments. The composite grade index of treatment No. 4 was higher than that for No. 2 before reduction, but only No. 5 was higher than No. 2 after reduction. The staple length of Nos. 3 and 5 (33.7) was significantly higher than that of No. 4 (33.2). Grade index before reduction was generally in the Strict Low Middling range, or the same as would be expected from spindle-picked cotton.

## Ginning Rate, Turnout, and Lint Foreign Matter

Ginning rate averaged 2.48 bales per hour, or about 62 percent of that expected from spindle-picked cotton on the same gin stand (table 6). Net turnout ranged from 21.0 to 22.5 percent, and averaged 21.8 percent. There were no significant differences among ginning treatments for either ginning rate or net turnout. Lint foreign matter, as determined by the Shirley analyzer, ranged from 2.72 to 3.66 percent and averaged 3.29 percent. Invisible waste was rather high. The 2.72-percent total waste of treatment No. 4 was significantly lower than all other treatments except No. 5. These total waste contents would normally be associated with Strict Low Middling grades.

TABLE 3.—*Moisture in seed cotton, seed, and lint*<sup>1</sup>  
[Percent]

| Gin treatment             | Seed-cotton moisture |           | Seed moisture | Lint moisture |
|---------------------------|----------------------|-----------|---------------|---------------|
|                           | At wagon             | At feeder |               |               |
| 1—Conventional .....      | 13.7                 | 11.9      | 12.4          | 3.8           |
| 2—Clean-extract—2LC ..... | 14.1                 | 10.3      | 12.5          | 3.8           |
| 3—Extract-clean—2LC ..... | 12.0                 | 10.0      | 11.8          | 4.0           |
| 4—Clean-extract—3LC ..... | 14.1                 | 10.1      | 12.4          | 3.9           |
| 5—Extract-clean—3LC ..... | 14.2                 | 10.2      | 12.6          | 4.2           |
| Average .....             | 13.6                 | 10.5      | 12.3          | 3.9           |

<sup>1</sup>Data in a column did not differ at the 5-percent level of significance, as determined by Duncan's multiple-range test.

TABLE 4.—*Smith-Doxey classification*<sup>1</sup>

| Gin treatment             | Grade before reduction (index) | Grade after reduction <sup>2</sup> (index) | Staple length (32d inch) | Micronaire |
|---------------------------|--------------------------------|--------------------------------------------|--------------------------|------------|
| 1—Conventional .....      | 91.0                           | 82.0                                       | 34.0                     | 3.8        |
| 2—Clean-extract—2LC ..... | 92.3                           | 83.3                                       | 34.3                     | 3.8        |
| 3—Extract-clean—2LC ..... | 89.3                           | 83.3                                       | 34.0                     | 3.8        |
| 4—Clean-extract—3LC ..... | 94.0                           | 88.0                                       | 34.0                     | 3.9        |
| 5—Extract-clean—3LC ..... | 91.0                           | 82.0                                       | 34.0                     | 3.9        |
| Average .....             | 91.5                           | 83.7                                       | 34.1                     | 3.8        |

<sup>1</sup>Data in a column did not differ at the 5-percent level of significance, as determined by Duncan's multiple-range test.

<sup>2</sup>Grade reductions were due to excessive bark content in the lint.

## Bale Weights and Values

Bale weights, unit lint values, and bale values were determined for the five ginning treatments (table 7). Bale weights are based on the turnout from 2,000 pounds of stripper-harvested material. Unit lint values and bale values were determined from both Commodity Credit Corporation (CCC) support prices for the area and from average mar-

ket prices in Greenville, S.C., for October 1972. There were no significant differences among ginning treatments for any measurement related to bale weights or values. However, the bale value of treatment No. 4, at \$108.53 market value, was approximately \$9 higher than No. 5, at \$99.30 per bale. This was due primarily to 13 pounds less lint from No. 5, where a stick machine was used first in the machinery sequence.

TABLE 5.—*Committee classification*<sup>1</sup>

| Gin treatment             | Color index | Leaf index | Composite grade index |                 | Staple length (32d inch) |
|---------------------------|-------------|------------|-----------------------|-----------------|--------------------------|
|                           |             |            | Before reduction      | After reduction |                          |
| 1—Conventional .....      | 98.7a       | 94.7a      | 93.6ab                | 84.8ab          | 33.4ab                   |
| 2—Clean-extract—2LC ..... | 96.1a       | 92.3a      | 89.8b                 | 84.2b           | 33.4ab                   |
| 3—Extract-clean—2LC ..... | 98.3a       | 94.3a      | 94.9ab                | 88.2ab          | 33.7a                    |
| 4—Clean-extract—3LC ..... | 98.7a       | 99.3a      | 99.0a                 | 92.4ab          | 33.2b                    |
| 5—Extract-clean—3LC ..... | 96.8a       | 95.0a      | 95.4ab                | 93.1a           | 33.7a                    |
| Average .....             | 97.7        | 95.1       | 94.5                  | 88.5            | 33.5                     |

<sup>1</sup>Means in a column not followed by a common letter differ at the 5-percent level of significance, as determined by Duncan's multiple-range test.

TABLE 6.—*Ginning rate, net turnout, and lint foreign-matter content*<sup>1</sup>

| Gin treatment             | Ginning rate (Bales/hour) | Net turnout (Percent) | Lint foreign matter <sup>2</sup> (percent) |                 |             |
|---------------------------|---------------------------|-----------------------|--------------------------------------------|-----------------|-------------|
|                           |                           |                       | Visible waste                              | Invisible waste | Total waste |
| 1—Conventional .....      | 2.43a                     | 22.5a                 | 2.0ab                                      | 1.6a            | 3.6ac       |
| 2—Clean-extract—2LC ..... | 2.46a                     | 21.5a                 | 2.2a                                       | 1.5a            | 3.7a        |
| 3—Extract-clean—2LC ..... | 2.47a                     | 22.5a                 | 1.9abc                                     | 1.7a            | 3.6ac       |
| 4—Clean-extract—3LC ..... | 2.52a                     | 21.7a                 | 1.3c                                       | 1.4a            | 2.7b        |
| 5—Extract-clean—3LC ..... | 2.54a                     | 21.0a                 | 1.5bc                                      | 1.4a            | 2.9bc       |
| Average .....             | 2.48                      | 21.8                  | 1.8                                        | 1.5             | 3.3         |

<sup>1</sup>Means in a column not followed by a common letter differ at the 5-percent level of significance, as determined by Duncan's multiple-range test.

<sup>2</sup>Determined by Shirley analyzer.

TABLE 7.—*Bale weights and values*<sup>1</sup>

| Gin treatment             | Bale weight (pounds) | Lint value (cents/lb) |              | Bale value (dollars) |              |
|---------------------------|----------------------|-----------------------|--------------|----------------------|--------------|
|                           |                      | CCC price             | Market price | CCC price            | Market price |
| 1—Conventional .....      | 449                  | 18.70                 | 23.59        | 83.88                | 105.79       |
| 2—Clean-extract—2LC ..... | 430                  | 18.87                 | 23.59        | 80.96                | 101.16       |
| 3—Extract-clean—2LC ..... | 451                  | 18.77                 | 23.50        | 85.15                | 106.72       |
| 4—Clean-extract—3LC ..... | 433                  | 20.17                 | 25.04        | 87.45                | 108.53       |
| 5—Extract-clean—3LC ..... | 420                  | 18.60                 | 23.59        | 78.72                | 99.30        |
| Average .....             | 436                  | 19.04                 | 23.86        | 83.23                | 104.30       |

<sup>1</sup>No data in a column differed at the 5-percent level of significance, as determined by Duncan's multiple-range test.

## Fiber Properties

Colorimeter yellowness, 2.5-percent span length, uniformity ratio, fiber strength, micronaire, and nep content did not reveal any differences among ginning treatments (table 8). The colorimeter reflectance of treatment Nos. 4 and 5 was significantly

(statistically) higher than that of No. 2, but the differences were minor. The range of ginning treatments did not adversely affect uniformity ratio or nep content. Although nep content ranged from a low of 34 to a high of 46, an increase of 35 percent, the difference was not significant. Fiber properties were generally low to average.

TABLE 8.—*Fiber properties*<sup>1</sup>

| Gin treatment         | Colorimeter reflectance ( $R_d$ ) | Colorimeter yellowness (+b) | 2.5-percent span length (inches) | Uniformity ratio (percent) | Fiber strength ½-inch gage (g/tex) | Micronaire | Neps/100 inch <sup>2</sup> of web |
|-----------------------|-----------------------------------|-----------------------------|----------------------------------|----------------------------|------------------------------------|------------|-----------------------------------|
| 1—Conventional .....  | 74.1ab                            | 8.6a                        | 1.08a                            | 42.3a                      | 22.9a                              | 3.9a       | 34.0a                             |
| 2—Clean-extract—2LC.. | 73.5b                             | 8.5a                        | 1.10a                            | 41.1a                      | 22.8a                              | 3.9a       | 44.2a                             |
| 3—Extract-clean—2LC.. | 74.1ab                            | 8.2a                        | 1.09a                            | 41.2a                      | 22.8a                              | 3.8a       | 39.3a                             |
| 4—Clean-extract—3LC.. | 74.6a                             | 8.7a                        | 1.07a                            | 41.7a                      | 23.3a                              | 3.9a       | 46.0a                             |
| 5—Extract-clean—3LC.. | 74.5a                             | 8.5a                        | 1.07a                            | 42.2a                      | 22.8a                              | 3.9a       | 44.0a                             |
| Average .....         | 74.2                              | 8.5                         | 1.08                             | 41.7                       | 22.9                               | 3.9        | 41.5                              |

<sup>1</sup>Means in a column not followed by a common letter differ at the 5-percent level of significance, as determined by Duncan's multiple-range test.

## CONCLUSIONS

Variations in sequence and amount of seed-cotton-cleaning and lint-cleaning equipment did not produce acceptable lint quality when applied to cotton harvested with a finger stripper from a narrow-row planting. Staple lengths and other fiber properties were comparable to those obtained from spindle picking, but grade reductions because of

bark content were excessive. The finger stripper is not likely to gain wide acceptance unless improvements are made in its field extractor or in gin extractors to increase stick-removal capabilities. Additional research should be conducted to evaluate the feasibility of finger stripping and narrow-row production in the Southeast in terms of agronomic characteristics, production potential, ginning performance, and cost reduction.

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